

**HWY-05-M-H035**  
**Wilmer, Texas**

# **Vehicle Group Chairman's Factual Report**

(25 pages)

**National Transportation Safety Board**  
**Office of Highway Safety**  
**Washington, DC 20594**

**Vehicle Group Chairman's Factual Report**

**A.    THE ACCIDENT**

<b>Type:</b>	Motorcoach Fire
<b>Date and Time:</b>	September 23, 2005 at about 6:07 a.m. (CDT)
<b>Location:</b>	Northbound Interstate 45, .2 miles south of Mars Road, near Wilmer, Dallas County, Texas
<b>Vehicle :</b>	1998 MCI, Model 102EL3, 54-passenger motorcoach
<b>Motor Carrier :</b>	Global Limo
<b>Fatalities:</b>	23
<b>Injuries:</b>	14
<b>NTSB Number:</b>	<b>HWY-05-M-H035</b>

**B.    VEHICLE FACTORS GROUP**

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### **C. ACCIDENT SUMMARY**

On September 23, 2005 at about 6:07 a.m. CDT, a 1998 MCI 54-passenger motorcoach was traveling northbound on Interstate Highway 45 (I-45) with 44 passengers and the driver, evacuating in anticipation of Hurricane Rita. The passengers were from an assisted living facility in Bellaire, Texas, and most needed to be carried or assisted onto the motorcoach by firefighters. The trip began about 2:30 p.m. on September 22, 2005. The motorcoach had been traveling over 13 hours in heavy traffic when the right rear (#3 axle) tire went flat and needed to be changed near the FM 1126 overpass in Rice, Texas. The tire left approximately 6,800 ft. of tire marks before the motorcoach came to a stop. A service mechanic was summoned to assist and he changed the tire. The motorcoach continued north on I-45 for about 26 miles.

At approximately 6:00 a.m. a motorist noticed the right rear (#3 axle) hub was glowing red/white hot. He was able to stop the motorcoach in the left traffic lane and told the driver (who did not speak English) of the danger. The motorcoach driver proceeded to pull the vehicle to the right shoulder, where he exited along with a nursing staff-passenger (the trip coordinator) and two other nurse-passengers and saw flames coming from the right rear wheel well. The passengers, with help from the nursing staff on-board and other motorist, began to disembark. At 6:07 the first call was made to 911. Fourteen intact oxygen cylinders were recovered from the motorcoach along with parts to possibly 4 others. One of those cylinders shows evidence of failure. Six nursing staff-passengers on the vehicle, a parent of one of the nursing staff, and 14 patient-passengers were able to exit the burning vehicle. Twenty-three patient-passengers, many of those who needed assistance in walking or needed to be carried off the vehicle were unable to escape.

#### **D. INCIDENT NEAR RICE, TEXAS**

(Note: This section is not meant to be a complete record of phone calls, official radio transmissions or other incidental occurrences surrounding the flat tire incident, but is here for the purpose of providing information relevant to the vehicle problems involved in the case.)

The MCI motorcoach was traveling northbound on Interstate 45 (I-45) at approximately 3:15 a.m. when just prior to the FM 1126<sup>1</sup> overpass, near Exit 239, the 3R<sup>2</sup> wheel locked up and began to leave tiremarks on the roadway. According to a forensic tire expert from Bridgestone/Firestone<sup>3</sup>, the initial 1500 feet of tiremark was characterized by a distinct five-rib tread appearance, indicative of an inflated tire (see photo #4). It then transitioned to a wider mark, having a flat tire appearance (see photo #5) and continued north for about 5300 feet. The tire expert from Bridgestone/Firestone believes that the transition point, from the distinct five-rib tread appearance to the wider tiremark, is the approximate location of the tire blowout.

During an interview with the driver, he related that he heard the tire blow out and then pulled over at a wide spot on the right shoulder, went back and observed the flat tire, then got back into the bus and continued northbound on I-45 in the right lane, attempting to find a more appropriate wide area to pull off the roadway. The location where he first pulled over to observe the flat tire was where FM 1126 enters I-45 northbound, which was about 1900 feet north of where the 3R tire and wheel originally locked and began to leave tiremarks on the roadway. An examination of the site revealed that if he had stayed there to have the tire changed it would have interfered with traffic entering I-45 northbound from FM 1126. After having traveled a total of about 6,800 feet north of the point where the initial wheel/tire lock occurred, the driver stopped in the right lane of travel. At some point prior to the bus making this final stop on the roadway, a woman on the bus from the nursing home staff called 911 for emergency assistance.

At 3:22 a.m., the communications center at Navarro Country Sheriff's Office received a 911 call from a cell phone, made by a nursing home staff member on the bus, who related to the dispatcher that the bus had a flat tire and they needed immediate assistance. After a series of exchanges between the caller and the bus driver in an attempt to ascertain their current location, the dispatcher informed the caller that she would send assistance and she dispatched a local policeman from Rice Police Department. Due to a special arrangement between the police and the W.W. Weber Construction Company, which was monitoring this highway construction area for displaced traffic control devices, they too were notified by the police of the disabled bus.

At approximately 3:45 a.m., K&S Tire Towing and Recovery, Inc., from Corsicana, Texas, received a call from an employee of the W.W. Webber Construction Company<sup>4</sup> reporting that a bus had a flat tire near MM (mile marker) 240. The owner of K&S towing received the call and in turn called one of his servicemen, awakened him and dispatched him to the scene.

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<sup>1</sup> FM is a Texas road designation, which abbreviates Farm to Market Road.

<sup>2</sup> The 3R wheel was mounted on the 3<sup>rd</sup> axle, right side, of the auxiliary weight-bearing axle, commonly referred to as the tag axle or trailing axle.

<sup>3</sup> A report from Bridgestone/Firestone is attached to this docket.

<sup>4</sup> The employee from W.W. Weber was patrolling the construction zone to ensure vehicles had not struck or moved cones and barriers. His assigned duties included obtaining assistance for motorists that needed aid.

According to the owner of K&S, he advised his serviceman of the urgency of the call. In an interview with NTSB investigators, he said that he told his serviceman "get up there and get them off the road".<sup>5</sup>

At about 4:26 a.m., the serviceman received a second call<sup>6</sup> from the owner of K&S while he was passing a convenience store called Lucky Lady's, located near MM 238, about 2 miles south of the disabled bus. According to the serviceman, he drove north on I-45, but got off at exit 238 due to traffic backup on I-45 and took the frontage road. (The frontage road was located about 100 feet east of I-45 and ran parallel to it.) He then drove north on the frontage road and when he arrived at the bus, he drove on the dirt median between I-45 and the frontage road and positioned his truck near the bus.

When the serviceman arrived at the scene at approximately 4:30 a.m. the Police Chief from Rice Police Department was already on-scene with his police car parked behind the bus with his vehicle lights illuminating the rear of the bus. The serviceman immediately went to work by turning on the truck-mounted work lights, starting up the gasoline engine which powered the air compressor, putting an air jack under the tag axle and jacking up the bus. Then with a heavy-duty impact wrench he removed the lug nuts and then the tire (see photos #6 and #7). The driver and other assistants had already taken the spare tire out of the compartment in the front of the motorcoach and had the tire positioned near the tag axle. The serviceman then attempted to put the tire on, but had to put a 2<sup>nd</sup> air jack under the tag axle to jack it up higher. The serviceman said that this involved him laying over the hub and contacting it. He said he did not notice the hub to have excessive heat. According to the serviceman, after positioning the tire on the threaded studs, he started the lug nuts with his bare hands and did not notice any unusual heat from the nuts. While he was securing the tire on the tag axle, the bus driver, with assistance from others, put the flat tire and rim back in the spare tire compartment. The serviceman estimated that the entire tire change took him less than 5 minutes.<sup>7</sup>

After the tire was changed and the flat tire and rim were placed in the spare tire compartment, the Police Chief from the City of Rice, advised the driver and the serviceman to go up to the next exit and complete their financial exchange. The serviceman then drove his truck up the frontage road for a distance of about ½ to 1 mile and pulled into the parking lot of an abandoned store where the bus was already there waiting for him. The parking lot was only a few hundred feet north from I-45 exit 242, where the bus exited the main highway. It was here that one of the nursing staff members<sup>8</sup> on the bus got off and furnished her credit card to the serviceman. A charge of \$90 was approved at 4:40 a.m. After completing the transaction, the serviceman returned to the K&S garage in Corsicana and the bus re-entered I-45 and continued northward.

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<sup>5</sup> The interview from Kenny Brown, owner of K&S Towing and Recovery, is attached to the Human Performance Group Chairman's Report.

<sup>6</sup> In an interview with the serviceman, he advised NTSB investigators that he was called twice by his boss, who told him "we need you there now".

<sup>7</sup> In a follow-up interview with the bus driver, Juan Robles, on April 5, 2006, he related through an interpreter that it took about 25 minutes to change the tire. However, the documented times furnished from the Navarro County Sheriff's Office and the time stamp on the credit card printout, from which payment was made to K&S for changing the tire, support the K&S serviceman's time estimates. (These supporting documents are attached to this docket.)

<sup>8</sup> The nursing home staff member stated that earlier in the trip she had to pay for fuel and stated that the driver was not prepared to pay for anything.

During the NTSB interview with the K&S serviceman, he said that he was unaware of the long tiremarks leading up to the location where the bus was stopped because he came up the service road and did not come up behind the bus. When questioned by NTSB investigators, he stated that no one mentioned the tiremarks to him. Further, he stated that he did not see the flat spot on the bottom of the rim. The serviceman also related that the driver never mentioned anything about the wheel lock-up prior to the tire blowing out. When questioned in a subsequent telephone interview and asked about his conversation with the driver, the serviceman indicated that his only interaction with the driver was when he handed him the invoice. At this point the driver acknowledged the bill, went back to the bus and got the woman from the nursing home staff to come out and she paid the bill with her credit card. The serviceman further stated that he did not know whether or not the driver spoke English because the driver did not say anything to him, except possibly "OK" when he handed him the bill. (This investigation has established through witnesses and the driver's own admission to interpreters, that the bus driver did not speak English.) The serviceman also said that if he had noticed any problem that indicated that it was more than a flat tire he would have advised the driver. Further, in a follow-up telephone conversation with NTSB personnel, the owner of the K&S Towing said that had they known about a problem with a wheel bearing that they could have fixed it, as it is a common occurrence for their company to change wheel bearings on the side of the road. The owner also stated that K&S has in stock about 90% of the wheel bearings used on trucks and buses.

The length of time from the initial lock-up of the 3R wheel near FM Road 1126 until the woman on the bus called 911 at 3:22 a.m. is not known. However, based on the documented times obtained from the Navarro County Sheriff's Department, it is estimated that least one hour and 10 minutes had elapsed from the time when the wheel locked-up until the serviceman actually put his fingers on the lug nuts.

An 84-year-old woman seated in aisle seat, row 10 on the right-side related, "it seemed that the driver was always riding the shoulder because [she] kept hearing what [she] thought was gravel kicking up". This passenger stated that she "kept hearing a gravelly noise while driving".<sup>9</sup> The position where this woman was seated would have been in the approximate area above the rear axles.<sup>10</sup>

#### **E. OBSERVATIONS OF VEHICLE PRIOR TO FIRE**

(Note: This section is not intended to be a complete account of all known witnesses who observed the bus prior to it catching on fire.)

In a follow-up interview with the serviceman from K&S Tire Towing and Recovery, he related that he saw the bus pull away from the vacant lot shortly after they completed their business transaction. Based on the time stamp on the credit card (4:40 a.m.) and the brevity of the encounter, it can only be estimated that the bus departed the vacant lot near Exit 242 between 4:45 and 5 a.m., and continued northward on I-45 at unknown speeds. At about 5:45 - 5:50 a.m.,

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<sup>9</sup> The interview summary of the 84 year-old woman is included in the Survival Factors Group Chairman Report.

<sup>10</sup> This interview was conducted the day after the bus fire occurrence. Therefore, the investigators, unaware of the circumstances leading to the first flat tire and eventually the fire, did not know what follow-up questions to ask the woman, such as when the noise started or if it ever quit. NTSB personnel have been unable to re-contact this bus passenger.

a motorist<sup>11</sup> traveling north on I-45, who departed his residence in Ennis (located near Exit 257), caught up with the bus near Trumbull, Texas, an unincorporated area near Exit 262. As it was still in the hours of darkness, the motorist noticed sparks coming from the lower right rear of the bus, and believed they were coming from the exhaust pipe. The motorist also related that while he thought the sparks were coming from the exhaust pipe, he never saw the pipe and didn't know where it was located.<sup>12</sup> The motorist stated that he didn't think much of the sparks because he just attributed it to carbon buildup in a diesel engine.

According to the motorist, as he continued northbound, at some point the traffic slowed to about 45 mph. As the motorist got closer to Wilmer, there was a white box truck, between him and the bus, flashing his headlights and he believed there must have been some type of problem with the bus. The bus, white box truck, and the motorist from Ennis, were all in the far left lane. The motorist was able to pull along the right side of the bus when he noticed the rear axle on the bus and described it to be "forge red, I mean, almost yellow from heat". He then passed and pulled in front of the bus and was able to get it stopped. He exited his pickup truck and went back to the left side of the bus and told the driver that "your right rear axle is red hot - it's almost on fire". The motorist stated that a lady in the bus got up and leaned toward the driver and the motorist told her, "I think you have a problem with the brakes". Shortly thereafter, the motorist got back into his vehicle and proceeded north; unaware of what action the driver took. In an NTSB interview with the motorist, he stated that he did not know if the driver spoke English or whether he understood him, as the driver did not speak to him.

The bus driver told investigators that when the motorist stopped him, he looked into his right mirror and saw flames. He then crossed over northbound traffic lanes, pulled onto the right shoulder, exited the bus along with a nursing staff member, and saw the 3R tire on fire.<sup>13</sup> After the fire was observed, the driver and nursing staff started to assist the passengers in getting off the bus. (According to highway documentation by NTSB personnel, the distance between the location where the bus was stopped by the motorist, to the location where the driver stopped the bus on the right shoulder was approximately 2,166 feet.)

Also on September 23, 2005, the day of the bus fire, a grass fire occurred near Exit 266, about 3.2 miles south of the site where the bus stopped and burned (see photo #8) This fire was in the median between the northbound and southbound lanes of I-45. It was reported to the Ferris Volunteer Fire Department at 6:04 a.m., which was about 3 minutes prior to the 911 call reporting the bus fire at 6:07 a.m.<sup>14</sup> Two metal objects were found at this site by NTSB investigators, which were similar in properties (color and weight) to the other rollers from the 3R outer wheel bearings of the bus (see photos #8 and #38). The metal objects weighed about 26 grams, which was about the same average weight (26.0791grams) of the other 4 rollers found in the hub and were determined by the metallurgists from the NTSB and ArvinMeritor to be rollers from the outer wheel bearing. One of the deformed rollers fit the contour of the 3R outer race<sup>15</sup> (see photo #40).

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<sup>11</sup> A complete transcript of the NTSB interview with this motorist is attached to the docket as "Human Performance Group Chairman's Report" attachment #4.

<sup>12</sup> The exhaust pipe on this bus is located on the lower left side of the rear of the bus.

<sup>13</sup> According to the forensic tire expert from Bridgestone/Firestone, the tire would have to reach a temperature of about 800 degrees F. for it to self-ignite.

<sup>14</sup> Refer to the NTSB Fire and Explosion Group Chairman's Factual Report for photos.

<sup>15</sup> A race is defined as the casing in which the bearings ride.

## **F. VEHICLE DAMAGE**

The bus was completely destroyed by fire, thus limiting the scope of the examination and testing. Therefore, no pneumatic testing could be done to the brake system nor could the transmission ECU or engine ECM be interrogated.

## **G. VEHICLE DESCRIPTION, MAINTENANCE AND INSPECTION**

The vehicle examination and inspection were conducted between September 26 and October 6, 2005 at the Dallas County Road and Bridge District Shop #3, located on Langdon Road in Dallas, Texas. The inspection was conducted by the NTSB Vehicle Group Chairman with assistance and participation by the Dallas County Sheriff's Department, the Texas Department of Public Safety, Federal Motor Carrier Safety Administration, Motor Coach Industries, ArvinMeritor Incorporated, and the Bridgestone/Firestone Tire Company. Additional component examinations took place at ArvinMeritor Incorporated in Troy, Michigan; Bendix Commercial Vehicle Systems in Elyria, Ohio and Bridgestone/Firestone in Akron, Ohio.

### **1. Vehicle Description:**

The involved vehicle was a 1998, MCI (Motor Coach Industries), Model 102EL3 "Renaissance", 54-passenger, restroom equipped, 45-foot motorcoach. The coach bore VIN (vehicle identification number) 1M8TRMTA2WP060300, Global Limo fleet number 717 and Texas Registration plate number T84305. The Texas license plate, number on the bus at the time of the fire, was for a 1991 Van Hool bus, also registered to Global Limo. During an interview with the driver, he related that he was instructed by the owner to take this plate from the Van Hool bus and affix it to the 1998 MCI bus involved in this fire. A Texas temporary cardboard plate for this bus was found by police inside one of the luggage compartments. It identified this bus by the correct VIN and the plate expired on 9/8/05. The odometer and DDEC ECM were destroyed by fire. However, an invoice from repairs done to the coach on September 14, 2005, 9 days before the fire, showed an odometer reading of 505,608.<sup>16</sup> The coach had a total length of 45.25 feet, a wheelbase of 26.25 feet<sup>17</sup> and a GVWR of 54,000 pounds.<sup>18</sup>

The bus was powered by an electronically controlled Detroit Diesel Series 60, 6-cylinder diesel engine, with a DDEC IV ECM (electronic control module). Under normal circumstances, this ECM produces a "Last Stop Record" that records speed, brake applications, engine rpm, percent of throttle and engine load, which is recorded any time the coach is stopped for more than 15 seconds. However, the DDEC IV ECM was damaged by the fire, thus destroying the

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<sup>16</sup> The odometer reading was recorded when an emergency repair was made by a mobile MCI repair crew near New Orleans during the Hurricane Katrina evacuation. The odometer reading of 505,608 was in kilometers, as the coach was originally delivered to a Canadian customer. (The MCI Invoice for 9/14/05 is attached to this docket.) Juan Robles, the driver of this bus when the repairs were made and was also the driver of the bus on September 23, 2005 when the fire occurred, related in the April 5, 2006, follow-up interview, that the speedometer was calibrated in kilometers.

<sup>17</sup> For MCI coaches, this measurement refers to the center of the front axle hub to the center of the drive axle hub.

<sup>18</sup> The listed GVWR (gross vehicle weight rating) for this motorcoach, when purchased, was listed in the 1997 MCI 102E Series Maintenance Manual as 49,900 pounds. However, MCI published Service Bulletin No. 2822 on April 12, 2002, increasing the GVWR to 54,900 for all E/EL/E4500 series coaches prior unit number 61327, which includes the bus in this fire. (A COPY of MCI Service Bulletin No. 2822 is included in this docket.)

recorded information. The coach had an Allison B-500R automatic transmission with a hydraulic retarder. The three axles on the vehicle were manufactured by ArvinMeritor. The first axle, model FH945CAX5, was a steering axle. The second axle, model RC23160NFCF82, was the drive axle. The third axle, model FH945CAX6, was an auxiliary weight-bearing axle, commonly referred to as the tag or trailing axle. The front steering axle was controlled by a ZF, model 8098, integral power steering gearbox. The tag axle was equipped with a ZF, model RAS, constant (full-time) power steering cylinder unit that turned the tag axle wheels any time the driver turned the steering wheel.

The vehicle was equipped with air brakes. All six wheel positions were equipped with D-LISA air disc brakes manufactured by ArvinMeritor. The vehicle was equipped with a 6-channel ABS (antilock brakes system) manufactured by Meritor WABCO.

## **2. Vehicle Maintenance:**

The purchasers of the bus, Robert J. McMynn and Joanne J. McMynn of Vancouver, British Columbia, Canada, took delivery of the bus in July of 1998. It was leased for about 2 years to AZ Bus Company in Toronto, Ontario, Canada, and then for about 3 months to Q Bus Company in Quebec. From December 2000 thru June 2004, it was leased to Royal Tours in Atlanta, Georgia, and then in May 2005 to MCT Charter Tours<sup>19</sup> from Beltsville, Maryland. The bus was then sub-leased by MCT Charter Tours to Global Limo in Pharr, Texas in May of 2005. According to the lease agreement between MCT and McMynn, the bus was not to be sub-leased.

No records were obtained from McMynn, MCT, or Global Limo that indicate that this motorcoach ever had a systematic scheduled preventative maintenance program. The NTSB obtained a portion of the repair and service invoices for this coach since 1998, dating from June 2004 to September 2005. Prior to the bus being sub-leased to Global Limo, it was worked on at Williams Detroit Diesel-Allison (billing address is Columbus, Ohio); J & M Tire International, Inc. in Oshawa, Ontario; Zenith Auto & Truck Collision in Vaughan, Ontario; Harper Detroit Diesel-Allison in Oshawa, Ontario; and Harper Detroit Diesel-Allison in Toronto, Ontario.<sup>20</sup>

**Note:** The following 3 pages is a summary of service and repairs made to this motorcoach based on what was written on the invoices. The invoices (all attached to this docket) vary greatly in detail. Some repairs and procedures listed may be subject to interpretation:

On an undated invoice from J & M Tire International of Oshawa, Ontario, it shows that unit #60300 was in for tire servicing. Under item description, it lists a quantity of 4, size 315/80R22.5 tires, apparently new tires purchased.<sup>21</sup>

An invoice from Williams Detroit Diesel-Allison, dated June 7, 2004, showed the bus was brought in for problems with the [radiator] fan drive. The work was billed to R&J McMynn Leasing and was paid with a Visa card on 6/24/04. It is unknown where this work was performed, but the Williams billing address was Columbus, Ohio. (The invoice had the number

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<sup>19</sup> MCT Charter Tours was assigned USDOT # 970041 and MC # 223785.

<sup>20</sup> Harper Detroit Diesel-Allison has 7 locations in Ontario, Canada. Therefore, after reviewing the invoices, it is unclear what work was performed in Toronto and what may have been performed in Oshawa.

<sup>21</sup> A copy of the J & M Tire invoice is attached to this docket.

60300 handwritten, which were the last 5 digits of the VIN number for this 1998 MCI motorcoach.)<sup>22</sup>

The photocopied invoice from Zenith is not easily legible, although the date appears to be October 04 (2004) and the total bill appears to be \$11,319. It lists the vehicle number as 60300 and states "Repair and Refinish as per estimate" and "Paid V#124, Nov.26/04". A photocopy of an undated list of mostly body parts appears to be from a parts affiliate of MCI. Although no date can be located, and the copy may not be complete, on the top of each page it shows the name "Zenith Auto & Truck Collision". One of the pages, typewritten, says "BUS # 60300" and the other 3 pages have the #60300 handwritten. One page says "Please contact MCI with the credit card information" and below it is written "order total \$4,613.89". A partial list of the parts are front windshield, rubber-baggage door (short), rubber- baggage door (long), fender S/A RR RH, door ASM switch, bumper S/A rear LH, bumper S/A rear RH, mirror ASM - exterior LH, mirror ASM - RH, EXT-Fender, LH RR rear section, EXT-Fender, RH front section, fastener - rear fender extension, windshield-front LH W/MASK, windshield-front RH W/MASK and other miscellaneous fasteners and components. On August 26, 2004, an invoice from MCI Service Parts, Ltd., of Toronto, Ontario, shows that a "Door ASM-SWITCH" was sold to R & J McMynn Leasing and shipped to Zenith Auto and Truck in Vaughan, Ontario.<sup>23</sup>

An incomplete invoice, with repair order number 489322-000, dated December 9, 2004, shows that the bus (unit #60300) was towed to Harper Detroit Diesel-Allison in Oshawa, Ontario because it would not start and there were blown fuses for the ECM and the starter motor stays engaged. The invoice shows about 30 electrically related items that were checked or repaired. This invoice does not show a dollar amount or when the bus was ready for delivery.

A Job Review for Repair Order number 489322-000 from Harper Detroit Diesel-Allison in Toronto, Ontario, dated February 9, 2005, shows an extensive list of items that were inspected, repaired or replaced. The exact list of procedures and repairs is as follows: Part (most likely means park) unit outside; jack up and put on stands; remove wishbone from front drive; remove old bushings; remove front drive; torque arms; broke two bolts; extract broken bolts; drill out hole and retap; install torque arm; remove jack stands; jack up front end and install jack stands; replace front steer axle torque arms; left one bent; check out front steer components; drag link is falling out; install charger - batteries dead; look for fuse book for ECM fuses - could not find; remove and install drag link assemblies; grease and tighten; should have aligned to recheck at next service; look for no power to ECM; no power in 5 wire power plug; look for fuses; take panels apart; found two blown fuses in box inside battery box; replace and test (ok); attempt to diagnose tag axle; fault light on; boost unit to start; perform total alignment; center steering wheel. The invoice, number 489322-000, dated 2/16/05, shows the total bill was \$9,140.56. (The bill listed 76.7 hours of labor at \$92.50 per hour, with the labor totaling \$7,094.75.)

A Job Review from Harper in Toronto, dated May 9, 2005, shows unit #60300 was brought in to have the brakes checked. The Job Review shows that the brakes were checked, to include measuring the brake pads, but it is not certain what else was done. The Job Review shows 3.5 hours labor @ \$92.50 per hour with a total bill of \$383.48.

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<sup>22</sup> A copy of the Williams Detroit Diesel-Allison invoice is attached to this docket.

<sup>23</sup> A copy of invoices from Zenith Auto and Truck Collision, a list of mostly body parts apparently from MCI and an ASM door switch from MCI Service Parts, Ltd., (7 pages) are all attached to this docket.

A Job Review from Harper in Toronto, dated May 12, 2005, shows unit #60300 was brought in to have the air conditioner repaired because the heating and A/C would not operate. The batteries were also checked and replaced with two new 8D 12-volt batteries. The total bill was \$1,176.14 and was paid with a Visa card on 6/30/05. On May 13, 2005, an additional Job Review shows more battery problems, lights not working, bus shutting down for low oil pressure and other related items. One remark is "Note: U-joints of differential will not take grease". The bottom item states, "Customer needed unit - Get bus running". The time stamp on the bottom of the Job Review is May 24, 2005 at 13:29:33 hours. The total bill, paid with a Visa card on 6/30/05, was \$734.09.<sup>24</sup>

On May 28, 2005, the bus crossed the border from Canada to the United States near Buffalo, New York.<sup>25</sup>

On May 31<sup>st</sup>, it was taken to the MCISS (MCI Sales and Service, Inc.) facility in Dallas, Texas. The complaint was that the batteries were losing their charge when the bus sits overnight, and the battery equalizer was replaced. Other repairs included adjusting the king valves and replacing missing caps in the A/C system, Freon added to the air conditioner, replaced left rear [suspension] air bag because the coach was leaning to the left, replaced entrance door sensor and adjusted door, replaced alternator belt due to dry rot, replaced miscellaneous exterior light bulbs, replaced battery door shock, replaced engine door shocks, replaced drive and tag axle tires with new Firestone FS400 tires and the fuel gauge was not working, but was not repaired due to time constraints. The customer was listed as Global Tours & Charters and the cost for the services was a total of \$7,572.96.<sup>26</sup> On June 3, 2005, an invoice from MCISS in Los Alamitos, CA states "Monitors come on - no picture when tape is put into VCP. Advised customer "Will need to order new VCP- Customer will order from Dallas. The cost for this was \$98.00."<sup>27</sup>

On June 14, 2005, the bus was taken to the MCISS center in Dallas with one of the main complaints being that the A/C was not cooling properly. The heater valve was rebuilt and motors were replaced on the drivers A/C. There was a problem with the VCR and radio, but they could not be repaired at that time, as parts would need to be ordered. Another complaint was that the windows (also known as emergency windows) were not latching properly. The technician observed bad bushings and latches on 9 windows. Repairs were made on windows #2, #3, and #6 on the left side and #2 and #3 on the right side. It was noted on the invoice that all latches and strikers needed to be replaced, but more parts needed to be ordered, as they had run out of parts. Another complaint was that the front end bounced at about 50 mph. The problem was diagnosed as needing new king pins, new brake rotors and front-end alignment, but the customer declined to have the work done. Other minor repairs were made to the mirrors and interior lights. The total bill for these repairs was \$3,451.38. Although the invoice listed Global Tours & Charters as the customer, "McMynn" was listed as paying part of this bill.<sup>28</sup> The mechanic who inspected the front end on this bus and diagnosed the king pins as being worn was interviewed by NTSB personnel on October 7, 2005. He reiterated that he specifically recalled the king pins

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<sup>24</sup> Copies of all the Job Reviews/ Invoices from Harper Detroit Diesel (7 pages) are attached to this docket.

<sup>25</sup> This information was based upon information from the U.S. Customs Service and is included in the NTSB Motor Carrier Group Chairman's Factual Report.

<sup>26</sup> A copy of the MCISS invoice for services in Dallas on May 31, 2005, is attached to this docket.

<sup>27</sup> A copy of the MCISS invoice for services in Dallas on June 3, 2005, is attached to this docket.

<sup>28</sup> A copy of the MCISS invoice for services in Dallas on June 14 and 15, 2005, is attached to this docket.

being worn, the front end needing alignment and that it needed new front brake rotors. He also recalled the front tires being bad and had flat spots.

On June 25, 2005, while on a trip returning from Las Vegas, Nevada, the bus stopped near El Paso, Texas, due to an automatic shut down of the engine and dead batteries. A serviceman came to the bus, replaced the batteries to start the bus and the driver drove a repair facility where it could be troubleshot. It was determined that the alternator needed to be replaced. The invoice did not identify the company that replaced the alternator. However, the invoice identifies the bus as #717, the fleet number issued to the coach by Global Limo. This information was verified in an interview with Juan Robles, the co-driver on that trip.<sup>29</sup>

On September 14, 2005, the bus was in Louisiana doing FEMA-related work during Hurricane Katrina. MCISS from Dallas had a Field Support Team working near New Orleans to support the heavy volume of motorcoaches involved in the relief effort. The driver, Juan Robles, made contact with the MCISS Field Support Team and informed them that he had a broken air drain valve on the left rear air tank. Due to the lack of parts, the MCISS mechanic took a drain valve from the left front suspension tank and installed it in the rear tank that had the broken valve. He then put a temporary plug in the left front tank. The mechanic noted on the repair order (RO 211399) that he "found system full of oil and carbon" and "checked ECAS (coach leveling system) because the driver stated the coach is going up and down on its own." The mechanic wrote "Coach most likely has plugged up ECAS valve body due to oil and carbon in the system, or leak on one of the air bags". There's no indication that this repair was authorized or made, most likely due to lack of parts.<sup>30</sup> (This mechanic was the same one who identified the front problems (king pins, rotors and tires on this bus at the MCISS in Dallas on June 14, 2005.)

On October 7, 2005, the mechanic, who worked on this coach on June 14<sup>th</sup> and on September 14<sup>th</sup> in Louisiana, was interviewed by NTSB personnel at the MCISS facility in Dallas. During the interview, the mechanic related that he recalled working on the Global Tours bus. He said that there was lots of oil, like mud in the air system and the AD-IP air dryer purge valve was stuck. The driver told him he had broken the [left rear air tank] drain valve. When asked, the mechanic also said, that in his opinion, the driver could not speak English.<sup>31</sup>

According to an NTSB interview with the driver on September 24<sup>th</sup>, he stated that new tires were put on the front just prior to the September 23<sup>rd</sup> trip with the nursing home residents.<sup>32</sup> However, according to the forensic tire expert from Bridgestone/Firestone, the new tires put on were undersize, 11R22.5 load range G. With the front axle loaded to the maximum allowed GAWR of 16,500 pounds, as it may have been for this trip,<sup>33</sup> it would have overloaded the front

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<sup>29</sup> A copy of this June 25, 2005 repair order (replaced alternator) is attached to this docket.

<sup>30</sup> The investigation did not determine why these repairs were not made. However, it is unlikely the mobile repair team would be stocking an ECAS valve or a suspension air bag. The MCISS technician, Felix Osuna, who worked on the bus spoke fluent Spanish, as did the Global Limo driver, Juan Robles.

<sup>31</sup> A copy of the MCISS invoice for September 14, 2005 is attached to this docket. It should be noted that although the invoice was incorrectly dated as "9/24/2005", it correctly refers to the coach being ready on "9/14/05".

<sup>32</sup> See September 24, 2005 interview with driver Juan Robles attached to the "Human Performance Group Chairman's Report".

<sup>33</sup> There were 45 occupants, including the driver, and the baggage compartments were loaded to capacity (see photo #19). Only four seats forward of the drive axle were unoccupied.

tires by about 33.6%.<sup>34</sup> The front tires should have been replaced with a 315/80R22.5 load range J (specified by MCI), each with an 8,270-pound load capacity.

On February 15, 2006, the NTSB Vehicle Group Chairman traveled to Pharr, Texas and visited Stewart and Stevenson (a Detroit Diesel and Allison Transmission service center) and Valley Volvo Truck Center. According to a supervisor at Stewart and Stevenson, Mr. Maples, owner of Global Limo, first came to them about 5 years ago to have some work done. A couple of mechanics informed the supervisor to use caution if Mr. Maples gave them a check as payment. The supervisor related that Mr. Maples had given them a check for the work performed and when he checked with the bank, he learned there were insufficient funds to cover the check. The supervisor related that over the past 5 years they have done work for Mr. Maples a few times, but it has always been in cash or on a "pay-as-you-go" basis.

On the afternoon of February 15, 2006, NTSB personnel, accompanied by an agent from the FMCSA (Federal Motor Carrier Safety Administration), visited Valley Volvo Truck Center in Pharr, Texas. The owner related that they have worked for Mr. Maples on numerous occasions, but that he was a problem, as he always contests the cost of the work. The owner related that Mr. Maples currently owes them over \$15,000 and that they have kept two of his buses as collateral. (The Global buses found parked in the rear lot of Valley Volvo were bus #602, a 1981 MCI, model MC-9, and bus #708, a 1987 Eagle, model 15.) The owner furnished records, which indicate that on August 8, 2005, Mr. Juan Robles (driver of the bus on the day of the fire), brought bus #717, the 1998 MCI involved in the fire, to Valley Volvo for servicing and repair. The items handwritten on the Repair Order were to change the transmission fluid and filter, winterization, PM (preventative maintenance) and that the coach was not building enough pressure (air pressure). This Repair Order was signed on the bottom by Juan Robles.

As a result of the Repair Order, the mechanics changed the transmission fluid and filter. For winterization, they discovered the radiator was leaking and it was removed from the bus and sent out for repair. After it was re-installed, new coolant was added. Regarding the coach not building air, an air leak was discovered in the air line from the compressor. Additionally, they discovered the compressor had a blown head gasket and it was removed, repaired and re-installed in the bus. (Note: On October 5, 2005, during the NTSB "on scene" inspection of this bus, the engine-mounted compressor was removed for further examination and possible testing. When extracting the six mounting bolts, it was discovered that four of them were loose.)

Regarding the PM (preventative maintenance), the service manager, Sotero Vela, was interviewed and asked what a PM would include.<sup>35</sup> He related that, at minimum, it would be an oil change with oil filters, fuel filters, air cleaner checked or replaced, and a grease job. The grease job would include greasing all fittings, checking the rear differential oil level, checking the oil level in the hub caps (for wheel bearing lubrication) and all other fluid levels. The mechanic who did the most of the grease job, Eduardo Valencia Garcia, had been working there for one year. He was questioned about checking the oil level in the hubs and he simply related

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<sup>34</sup> Refer to Forensic Tire Report - Bridgestone/Firestone

<sup>35</sup> At the time of this interview, the service manager stated that he had only been working at Valley Volvo for about 3 months and was not employed there when this work was done on the fire-destroyed motorcoach.

that he did it. Further, he stated that he did not see any oil around the wheels, which would usually indicate a worn wheel seal that is leaking.<sup>36</sup>

On November 28, 2005, the FMCSA (Federal Motor Carrier Safety Administration) furnished an undated letter to the NTSB from Mr. Eric W. McAuley, owner of a private vehicle repair shop in Aransas Pass, Texas. In summary, the owner of the repair shop detailed dates of the repairs and in some cases the bus number, the reason for the repairs, or that the owner of the bus declined to have the repairs made. Mr. McAuley related that they started working on Global Limo buses on April 15, 2005 and the last coach to visit his shop was July 16, 2005. During this time span, there were 5 buses that visited his repair facility. In one case on June 12, 2005, a bus was brought in with a complaint that the parking brakes were not working. The mechanic found that the shoes and drums were worn to the extent that, even after adjusting the brakes, he could not get the shoes to touch the drums. When he called Mr. Maples, owner of Global Limo, he told him that he wanted the bus to make one more run with the bus and that he would send the parts to have the bus fixed. The bus departed his facility with neither parking nor service brakes on the drive axle. During the time he worked on Global buses, Global drivers advised him that it was difficult for them to have even minor repairs done on the buses. He was also warned by the drivers not to use his own money for parts. Mr. McAuley related that Mr. Maples did not pay for at least two repairs and eventually he decided not to work on Mr. Maples's buses any more. In conjunction with the information furnished in this letter, he was interviewed by FMCSA.<sup>37</sup>

On October 7, 2005, Global Limo, Inc., was served with an "Operations Out - of - Service Order" by the FMCSA, which stated "The United States finds your motor coach operations constitute an 'imminent hazard'. It also stated "the basis for determining that Global Limo's motor carrier operation poses an 'imminent hazard' to the public in that Global Limo currently operates vehicles that are in a mechanically unsafe operating condition and, if operated, pose and imminent hazard to the public and further, that Global Limo fails to insure that its vehicles are properly and regularly inspected, repaired and maintained thereby posing a continuing imminent hazard to the public". On September 24, 2005, the FMCSA conducted a compliance review of Global Limo, Inc. and they were given an "Unsatisfactory" rating. With regards to the buses, the Operations Out -of -Service Order stated: "The Compliance Review concluded that Global Limo has a grossly ineffective or nonexistent inspection, repair and maintenance program".<sup>38</sup>

### **3. Vehicle Inspection:**

#### **a. Wheels, hubs, bearings and brakes:**

The NTSB Vehicle Group assembled at the Dallas County Road and Bridge District Shop #3, located in Dallas, Texas, on September 26, 2005 to begin the inspection of the fire-destroyed motorcoach. Based on information furnished by the Sheriff's Department, Texas DPS, and coupled with the appearance of the 3R tire and wheel assembly, it was apparent that there was a problem in the area of the 3R wheel, as this was the only wheel where the tire was burned

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<sup>36</sup> Copies of the Repair Order and Invoice from Valley Volvo (6 pages) are attached to this docket.

<sup>37</sup> A copy of the letter from Mr. Eric McAuley is attached to this docket.

<sup>38</sup> A complete copy of the FMCSA "Operations Out -of - Service Order", with supporting documentation is attached to the NTSB Motor Carrier Operations Group Chairman Report.

completely off the rim and had only metal wire components remaining. Also, as mentioned previously, the driver related that he first noticed the fire on the 3R tire and, prior to a fire being observed; it was the 3R axle that the witness related was glowing "forge red".

The coach was equipped with ArvinMeritor; model D-LISA (see photos #55 and #56), air actuated disc brakes on all 6 wheels.<sup>39</sup> Although the exact percentage of buses with disc brakes is not known, disc brakes are being increasingly used in motorcoaches, with disc brakes being a standard feature on some models of motorcoaches. Like drum brakes, which have been the industry standard since at least the 1940's, disc brakes have similar type air chambers. However, in drum brakes, the automatic adjustment occurs through the slack adjuster. In disc brakes, the automatic adjusting mechanism is located inside the brake caliper assembly. The following is a basic explanation of how disc brakes work:

The driver makes a service brake application utilizing the brake pedal (treadle valve), which signals the relay valve to supply the air chambers with a volume of air in proportion to the force of the driver's foot application of the brake pedal. The push rod is then forced out of the air chamber and rotates the disc brake actuation lever (similar in appearance to a short length manual slack adjuster body), causing the caliper actuation pistons to move outward and forcing the inner brake pad in contact with the rotor. The inner brake "pad to rotor" contact results in the caliper assembly<sup>40</sup> sliding inward, which forces the outer pad in contact with the outboard side of the rotor. Since the rotor is mounted on the rotating axle hub<sup>41</sup>, the friction created between the rotor and brake lining causes the wheels to retard, ultimately slowing or stopping the vehicle.

The service brake air chambers were Type 24 for the front axle, Type 30 for the drive axle and Type 20 for the tag axle. All air chambers were MGM "long stroke", but only the drive and tag axle had spring parking/emergency brakes. The four power coil springs<sup>42</sup> and their housings, both from the drive and tag axle brake chambers, became separated from the service chamber during the fire. Further, all of the brake hoses were either completely destroyed by fire or burned to the point where they would not hold air, thus precluding any functional testing of the air system.

In order to familiarize the Vehicle Group with the various wheel components, the inspection began with the 3L tag axle (3<sup>rd</sup> axle, left side) wheel. The 3L wheel, hub and brake assembly and other related components were examined, photographed and removed for the purposes of examination and comparison to the 3R components. (An officer from the Dallas County Sheriff's Department progressively photographed all vehicle component and system

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<sup>39</sup> A copy of Meritor, Maintenance Manual MM-99108 for the D-LISA "Air Actuated Disc Brake", is attached to this docket.

<sup>40</sup> The *caliper assembly* houses the internal actuating components and caliper mechanism and maintains correct brake shoe contact with the carrier. The caliper is supported on two slide pin assemblies that are bolted to the carrier. The assemblies enable the brake shoes (pads) to self-align during actuation and allow for brake shoe wear. (Source: Meritor, Maintenance Manual MM-99-108, for the D-LISA "Air Actuated Disc Brake".)

<sup>41</sup> The hub is mounted on the outer axle assembly and serves a multiple purpose: the tire rim is mounted to the hub; it serves as encasement for the wheel bearings; the hub cavity serves as a reservoir for oil when equipped with disc brakes; and it serves as the mounting hardware for the brake rotor.

<sup>42</sup> The power coil spring is a heavy-duty spring, located in the parking brake chamber, which is used to hold the vehicle in a parking situation by mechanical means, rather than air pressure. The power coil spring in the "spring brake system" is normally applied by the driver when parking the vehicle. In the case of low air pressure, it is applied automatically. In rare situations, it can be used as an emergency brake.

disassemblies and component removals.<sup>43</sup>) The rubber "fill-cap" (also referred to as the "fill plug"), where oil is put into the hub cavity to lubricate the wheel bearings, was missing and a significant amount of water was found in the hub cavity (see photo #21). It is unknown if the "fill-cap" was present prior to the fire. However, the rubber "fill-cap" could not have withstood the heat of the fire and would have burned or melted.

The 3L wheel, hub and brake components appeared generally unremarkable, although a small section of one of the brake pads was missing, a violation of the Federal Motor Carrier Safety Regulations<sup>44</sup>, although the brake pads were above the minimal required thickness of 1/8 inch (0.125 inch)<sup>45</sup>. The wheel bearing hub cavity was low on lubricant, with only residual traces of oil on the bearing elements,<sup>46</sup> although the bearings were still intact and in good condition with no obvious signs of wear or excessive heat. The 3L tone ring and adjoining axle torque plate were encrusted with oil (see photo #24), which coupled with the low oil level in the hub cavity, was an indication that oil was leaking from the wheel seal. The maximum thickness of the brake rotor was measured at 1.546 inches, which was below the manufacturer's minimum rotor thickness specification of 1.625 inches for this rotor.<sup>47</sup>

The hubcap serves as part of the reservoir for the wheel lubrication fluid. The 3L hubcap was made of steel. The 3R hubcap, made of aluminum, which melts at about 1150 degrees F.<sup>48</sup>, melted after the wheel became over heated. According to an MCI representative, this coach was originally equipped with aluminum hubcaps on the tag axle, a fact that indicates maintenance was performed on the 3L wheel that included replacing the hubcap. The maintenance records in the possession of the NTSB do not show a change of hubcaps or other repairs to the 3L wheel that would require having the hubcap replaced. Federal regulations require that maintenance

records be kept only "for a period of 1 year [while the vehicle is in the carrier's possession] and for 6 months after the vehicle leaves the motor carrier's control."<sup>49</sup> (The NTSB has obtained maintenance and repair records for this motorcoach from June 7, 2004, when Williams Detroit Diesel-Allison repaired a radiator fan, to September 14, 2005, when field repairs were made in Louisiana during Hurricane Katrina by the mobile emergency repair team from MCI Service and Sales in Dallas, Texas. However, it is not known if the records are all-inclusive.)

The 3R wheel was examined and photographed prior to removing any wheel components. During the 3R wheel examination and before the disassembly of any components, the following

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<sup>43</sup> At the request of the Sheriff's Department, the NTSB agreed to let the Sheriff's Department take all of the photographs. Therefore, no one was permitted to take photographs of the bus or any mechanical components during the NTSB mechanical inspection other than the photographer from the Sheriff's Department. This did not preclude the taking of photographs by NTSB members, or others, investigating the fire itself, survival aspects of the investigation, oxygen canisters, etc.

<sup>44</sup> This missing portion of the brake lining (pad) is a violation of FMCSR, Title 49, Part 393.47, and was so noted on the Texas Department of Public Safety inspection report. (A copy of the Texas DPS Inspection Report is attached to this docket.)

<sup>45</sup> The minimum brake lining (pad) thickness for disc brakes is established in the FMCSR (Federal Motor Carrier Safety Regulations, Title 49, Chapter III, Subchapter B, Appendix G. 1(c), which is a reference for Part 396, "Inspection, Repair and Maintenance".

<sup>46</sup> The NTSB took samples of the liquid in the 3L hub cavity. However, as the liquid was nearly all water, the residual traces of oil were not enough for a test sample, thus no determinations were made concerning the small amount of oil collected.

<sup>47</sup> The manufacturer's minimum rotor thickness specification is that which is cast in the rotor; or 1.61 inches, whichever is larger. In this case, the cast measurement on the rotor was 1.625 inches. (Source: Meritor, Air-Actuated Disc Brake, Maintenance Manual MM-9910, page 20, for the D-LISA disc brake.) There are currently no federal standards listed in the FMCSR that address the thickness of disc brake rotors.

<sup>48</sup> See "Lowest Melting Temperature" chart contained in this report.

<sup>49</sup> FMCSR, Title 49, Part 396 "Inspection, Repair, and Maintenance", Section 396.3 (c).

observations were made: the aluminum hubcap was melted away, but several small fragments of aluminum were still present around the hubcap mounting bolts (see photo #33 and #34); the rubber from the tire was burned and no rubber was observed (see photo #29); the outer end of the spindle was non-concentric with the hub and the inner wheel bearing nut (adjusting nut) was against the inner hub at about an 11 o'clock position (see photo #30); at least two rollers from the outer wheel bearing, flattened due to being overheated (see photo #38), and several other rollers were visible in the space between the wheel bearing jam nut and the inner hub (see photo #36); and the bottom of the wheel rim was flattened and had a chord length of about 9.5 inches and chord height of about 1 inch (see photos #30 and #31). When police initially examined the bus at roadside where the fire occurred, much of the wire used to construct the tire was still wrapped around the rim or along side the rim and a broken corner piece of the disc brake carrier was found lodged in the tire rim hand hole at about the 11 o'clock position (see photos #13 to #16).

The 3R wheel rim was then removed using an impact wrench, thus exposing the hub and disc brake assembly. The following observations were made of the disc brake assembly, with some of the observations made prior to the removal of the rotor and some after its removal: The top of the rotor was observed to be tilted outward (see photos #46 and #47) and the bottom of the rotor was against the torque plate where fresh grinding marks on the torque plate were observed (see photo #44, with torque plate removed from vehicle and inverted). In normal vehicle operation, the vertical mounted rotor does not make contact with the torque plate, neither with the rotor turning while the vehicle is moving, nor when the brakes are applied. There were grinding marks on the underside of the caliper housing and the rotor was found in contact with it. Further, the forward section of the caliper housing was completely separated (see photo #46). The brake pad retaining pins, normally round, had flat spots from obvious contact with the rotor<sup>50</sup> (see photo #47). The 3R outside brake pad was worn more on the top and the 3R inside pad worn heavier at the bottom (see photo #54), all of which is consistent with wear from the displaced and tilted rotor.<sup>51</sup> A corner section of the carrier was broken off and was found in the 11 o'clock wheel hand hole when the bus was at the scene where the fire occurred (see photos #14 and #15). The outboard section of the caliper carrier was also broken away (see photo #49) and found inside the wheel when removed during the vehicle inspection.

After examining portions of the disc brake assembly, the hub was removed by first removing the outer bearing jam nut, bend tab lock washer, and the lock ring. The adjusting nut could not be removed by backing it off with a wrench on the spindle threads, per normal procedure, because it spun on the threads. The Vehicle Group decided against cutting it in the interest of preserving evidence and a local machinist was summoned, who was able to remove the adjusting nut without cutting it. The hub and rotor assembly was removed from the spindle by pulling it over the damaged outer bearing cone that was fused to the spindle. The disfigured wheel bearing rollers and the damaged disc brake assembly were now exposed.

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<sup>50</sup> The clearance between the rotor outside diameter and the underside of the caliper housing surface is approximately 0.17 inch. (Source: ArvinMeritor)

<sup>51</sup> According to ArvinMeritor engineers, the running clearance, which is the distance between the brake pads and the rotor, with the brakes in the released (unapplied position), is 0.012 - 0.039 inches.

Only 4 deformed (flattened) rollers for the outer wheel bearing could be located in the hub. Two more rollers were found in the area of the grass fire near MP 266 (as mentioned in Section E of this report). The originally installed outer bearings had 19 rollers. Although the outer bearing required standard industry<sup>52</sup> part number 555-S/552A, that would not indicate exactly how many rollers there were in the bearing cage. The inner bearing, containing about 17 rollers, required industry standard part number 6461A/6420 and was larger than the outer wheel bearing. About 8 or 9 rollers, located approximately from the 11 o'clock position to the 4 o'clock position, were found fused together on the inner bearing race, with the two rollers near the 3 o'clock position severely deformed (see photo #42) and the bearing cage destroyed. The minimum diameter for the outboard rollers was .486 inches and .622 inches for the inner rollers. The inner wheel seal was destroyed by fire and could not be examined.

According to the "Lowest Temperature Melting Chart" (below), the rollers for the bearings required temperatures of about 2400 degrees F. to melt, whereas the brake rotor and carrier required only 2,100 degrees F. Although the exact temperature was not established, the point at which the rollers become malleable (hot working temperature<sup>53</sup>) is somewhat less than 2400 degrees F. According to several bearing experts<sup>54</sup>, it would not have been possible for the rollers to deform and begin to melt if there was sufficient lubrication in the hub cavity.

Although the bus had a PM (preventative maintenance) done sometime between August 8 and 12, in Pharr, Texas, it cannot be stated with certainty if the 3R wheel had oil leaks at this time. According to a representative from MCI Engineering, any oil leaks from wheel seals in the steer or tag axle can only be observed from underneath the coach, as they would not be visible from standing alongside the coach, as would be the case with the drive axle. This is because the wheel rim is mounted to the vehicle with the convex center of the wheel facing the outside of the vehicle.<sup>55</sup> Further, according to the current CVSA (Commercial Vehicle Safety Alliance) criteria, a leaking wheel seal alone is not an out-of-service item, but is only "out-of-service" if the hubcap is missing or broken, allowing an open view into the hub assembly; or, if the wheel is smoking due to bearing failure.<sup>56</sup>

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<sup>52</sup> All of the bearing manufacturers utilize the same number system for common bearings. The *standard industry* number provides information about the bearing specifications, but does not indicate the manufacturer or the number of rollers.

<sup>53</sup> According an engineer from Timken, the "hot working temperature", is not a specific temperature, but the point where the material gets easier to move, such as rolling out under the bearing loads. According to the Timken engineer, in this case these rollers would have reached the "hot working temperature" at about 2,100 degrees F.

<sup>54</sup> This inquiry was made to experts at The Timken Company (formerly Timken Roller Bearing), NTN-Bower and ArvinMeritor.

<sup>55</sup> The concave outside wheel mounting is normal for steer axles of truck and buses and for the tag axle of all motorcoaches.

<sup>56</sup> Commercial Vehicle Safety Alliance, North American Standard "Out-of-Service" Criteria, section 12.i.(1) and (2). (Edition: April 1,2005)

## Melting Points of Various Metals Used on Wheels and Brakes

### Lowest Temperature Melting Chart (for the alloy listed)

Material	Melting starts at the following Temperature, °F	Damage
Roller Bearing, Steel base material, 0.20% carbon steel, typical	2,723	Melting damage was observed in several bearing rollers
Roller Bearing, Carburized layer portion, As much as 1% carbon steel	2,400	Melting damage was observed in the carburized layer portion of several bearing rollers
Cones for the roller bearing, Similar material as rollers	Same as rollers	Melting damage was observed in several areas.
Spindle, Steel base material, 0.35% carbon steel, typical	2,723	No evidence of melting damage
Rotor and Carrier Ductile Iron casting, between 3% and 4% carbon, typical	2,100	No evidence of melting damage
Wheel Rim, Steel base material, 0.20 % carbon steel, typical	2,723	No evidence of melting damage, Grinding damage was found
Cap for Wheel Rim, Aluminum Casting, between 3% and 6% silicon, typical	1,150	Resolidified fragments of the cap was found on the attachment bolts for the wheel rim

Source: Table was prepared by Frank Zakar, Metallurgist, NTSB Materials Laboratory  
Temperatures were obtained from the ASM Handbook (formerly American Society for Metals),  
Copyright 1991

The MCI Maintenance Manual for this motorcoach says "Check the wheel bearing lubricating oil levels daily. If oil is not visible at the sight gauge (commonly referred to as the "sight glass") level mark, add sufficient oil."<sup>57</sup> There are two other places in the same MCI Maintenance Manual that states it should be checked daily<sup>58</sup> and one section that states it should be check every 1,000 miles<sup>59</sup> This is something that can be done for the steering and tag axle wheels and some carriers require the driver to check the "sight glass" as part of a pre-trip inspection. The drive axle wheel bearings have oil fed to them from the rear differential and the oil then runs outward through the axle housing to feed the wheel bearings. Evidence of a leaking wheel seal in the drive axle is usually visible from standing along the outside the motorcoach.

<sup>57</sup> Source: MCI 102E Series Maintenance Manual, November 1997, Page 15B-1 and 15B-2. This refers only to the front and tag axles (axle #1 and #3). A copy of Section 15 of this manual, "Wheels, Hubs and Tires" is attached to this docket.

<sup>58</sup> Ibid, Section 10 - LUBRICATION, pages 10-4 and 10-5, states that oil lubrication for the steer and tag axle be checked daily.

<sup>59</sup> Ibid, Section 1 - FRONT AXLE, page 1-19, states oil lubricated wheel bearing should be checked every 1,000 miles.

However, according to MCI engineers, a worn seal that is causing a leak in the steer or tag axle can only be observed from underneath the motorcoach and is generally considered to be a task for a mechanic or serviceman. In this case the motorcoach was equipped with aluminum wheels with small round holes, making it even more unlikely that an observer standing along side the motorcoach could see signs of a leaking wheel seal.

For the purpose of comparison, the Prevost Maintenance Manual for H3-45, also a 45-foot 3-axle motorcoach with oil lubricated wheel bearings for the steer and tag axle. The manual states: "A sight glass is provided for convenient verification of oil level. Oil level should be checked daily and must be maintained between the ADD and FULL level mark in the sight glass or between 15/16" and 1 3/16" from the wheel centerline."<sup>60</sup>)

During an NTSB interview with the driver on April 5, 2006, he related through an interpreter that he knew how wheel bearings were lubricated, but that he had never lubricated them himself. He stated that he had not checked the wheel bearing oil in any bus. He further related that he did not notice signs of a leaking wheel on the 3R axle of this bus at any time prior to the fire and that he thinks he would have noticed it. Further, he did not notice the "fill plug" missing, but thinks he would have noticed if it were missing. He also related that he has never had a wheel bearing go bad on any bus he has driven. When questioned about whether the tag axle had a hard impact prior to the fire, he related that he did not think so. The NTSB did not specifically ask the driver if he had ever crawled under the coach to check for wheel bearing leaks in the tag or steer axle. However, he related that Mr. Maples did not require the drivers to do a Pre-Trip inspection, but that he did one on his own, which included tapping the tires, checking the water and checking oil, because he wanted to make sure the bus was okay for the trip.

As the inspection continued, the wheels on the drive axle were removed and the disc brakes and linings (brake pads) were examined. The average thickness for the 2R rotor was 1.511 inches, substantially below the manufacturer's minimum rotor thickness specification. The 2R rotor also had 3 transverse cracks through the inboard cheek and one transverse crack through the outboard cheek (see photos #58 and #59). The oil in the differential was checked and was found to be 1.4 inches below the bottom of the fill hole."<sup>61</sup> According to ArvinMeritor engineers, the differential oil capacity for the RC23160NFCF82 drive axle was approximately 37 pints. By using a computerized model, it was calculated to be about 10 pints low on oil. Although the oil was significantly low, it was the opinion of ArvinMeritor engineers that this oil level was not necessarily critical as far as providing sufficient lubrication to the differential gears and the wheel bearings. An examination of the 2L drive axle components was unremarkable. .

When examining the wheels and brakes for the 1L axle, the mechanic utilized a short hand wrench to remove the retaining bolts for the disc brake carrier from the torque plate (also called axle mounting flange). These bolts were removed with ease by utilizing the hand wrench.

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<sup>60</sup> From "Prevost Coach Manufacturer", Section 13, page 13-7. This manual is not specifically dated, but the H3-45 is a late model coach and other reference material found in the manual is dated 2000. (A copy of this page is attached to this docket.)

<sup>61</sup> The common method used by mechanics for checking the differential fluid level is to remove the "fill plug", put their index finger in the "fill hole" and then bend the outer joint of the finger downward to see if the lubrication fluid contacts the finger tip. If it touches the oil level, it indicates there is sufficient oil, even though it should be filled to the "fill hole".

The carrier retaining bolts must be tightened to between 345 to 405 lb-ft.<sup>62</sup> and removing them from the other wheels required a heavy-duty impact wrench. The average thickness for the 1L rotor was 1.649 inches, or 0.024 inch above the manufacturer's minimum rotor thickness specification. (The 1L worn king pins are noted in section 3b, Steer Axle section of this report.)

When the motorcoach was at MCISS (MCI Sales and Service) in Dallas on June 14, 2005, about 3 months prior to the fire, Global Limo was advised that the rotors were bad, but Global declined having the repairs made.<sup>63</sup> It cannot be stated for certain whether the rotor that was on the 1L brake during the post-fire inspection was the same one that was seen by MCISS on June 14<sup>th</sup>, as the one examined in the post-fire inspection was not cracked and was 0.024 inches above the minimum required thickness. The fact that the carrier retaining bolts were only hand tight could indicate that the mechanic who installed the retaining bolts did not properly torque the carrier to the torque plate, especially since the other carriers required a heavy duty impact wrench to remove. The date code on the 1L rotor, 1339,<sup>64</sup> shows that was not the original rotor utilized when the bus was manufactured. The NTSB did not obtain any repair records that would show the 1L rotor being replaced between June 14 and September 23, 2006.

The 1R steer axle components were then examined. Everything appeared normal, except for the rotor being worn to an average thickness of 1.538 inches, which is below the manufacturer's minimum rotor thickness of 1.625 inches, which was cast on the rotor. The following is a complete list of the average rotor thickness and average brake lining thickness by wheel position:

### **Rotor and Brake Lining (brake pad) Measurements**

	Average Rotor Thickness	Average Brake Lining Thickness	
		Outboard	Inboard
1L	1.649 inches	0.301 inch	0.364 inch
1R	1.538 inches*	0.270 inch	0.340 inch
2L	1.636 inches	0.281 inch	0.351 inch
2R	1.511 inches*	0.297 inch	0.324 inch
3L	1.545 inches*	0.318 inch**	0.350 inch
3R	1.558 inches*	0.232 inch	0.271 inch
* Indicates rotor is below the manufacturer's minimum rotor thickness of 1.625 inches, which was cast on the rotor.			
** Indicates portions of lining material missing (violation listed by Texas DPS). All linings were above minimum thickness of 1/8 inch (0.125 inch), as required by FMCSR.			

<sup>62</sup> Source: Meritor, "Air Actuated Disc Brake" Maintenance Manual MM-99108, Section 6, page 15.

<sup>63</sup> MCISS invoice, dated 6/14/2005, RO number 210796, notes "rotors bad". This was the same invoice that listed the worn king pins and noted that the front end needed to be aligned. (A copy of this invoice is attached to this docket.)

<sup>64</sup> According to an ArvinMeritor representative, the date code of "1339" means this rotor was manufactured during the 133<sup>rd</sup> day of 1999, or in May of 1999. This manufacture date was about 10 months after the coach delivery date of July 1998.

**b. Front Axle (Steer axle):**

On June 14, 2005, the motorcoach was taken to the MCI Sales and Service Center in Dallas. The invoice (RO number 210796) states "*Complaint: Make estimate to repair for front end bounces at about 50 mph; Cause: king pins worn, rotors bad, need aligned; Corrective Action: Checked front end and found too much play up and down, left and right, on left side king pin. Found bad front rotors, and coach needs an alignment. Customer declined all repairs at this time. Greased Chassis.*"<sup>65</sup>

On October 4-5, 2005, during the NTSB Vehicle Group post-fire inspection of the steer axle, king pin end-play measurements were taken on both sides of the front axle. After the measurements were taken, the king pins and steering knuckles were removed from the coach, visual inspections were made of the king pins and knuckle bushings, and upper and lower knuckle bushing bore measurements were taken.

The left side upper lateral endplay measurement was 0.055 inches and the lower lateral endplay measurement was 0.022 inches, both of which exceeded the manufacturer's recommended limit of 0.010 inches. The average left side upper knuckle bushing bore measurement was 1.899 inches and the average lower knuckle bushing bore measurement was 1.801 inches, both of which exceed the manufacturer's recommended limit of 1.796 inches. The visual inspection of the left side king pin and knuckle bushings indicated that the upper knuckle bushing was worn and dry of lubricant and corrosion was on the mating surface of the king pin.

The right side lateral and vertical king pin endplay measurements and steering knuckle bushing bore measurements were within the manufacturer's recommended limits. The visual appearances of the right side king pin and knuckle bushings were unremarkable.

**c. Wheels, brakes and axle related evidence:**

Wheel, hub and brake components from the 3R, 3L, 1L, and 1R axles, as well as the ABS ECM, were crated or boxed and shipped to ArvinMeritor for examination and testing. The crating and shipping occurred at two different times. On November 8, 2005, at the request of the NTSB, personnel from ArvinMeritor, MCI, The Timken Company, NTN Bearing and Bridgestone/ Firestone met at the ArvinMeritor headquarters in Troy, Michigan for a technical meeting and to examine the shipped components. Also present was the NTSB Vehicle Group Chairman and a metallurgist from the NTSB. With the aforementioned group present, the sealed crates were opened and the components were removed for the purpose of examination and taking photographs. There was no destructive testing. On November 9<sup>th</sup>, 2005, the components were re-packaged in one large wooden crate and sealed in the presence of personnel from ArvinMeritor and the NTSB. The NTSB Vehicle Group Chairman signed and dated the crate. At the request of the NTSB, ArvinMeritor agreed to keep the crate in secured evidence until the Dallas County Sheriff's Department was ready to receive it back into evidence, as they lacked the space for this large amount of evidence. The sealed crate was returned to the Evidence Unit at the Dallas County Sheriff's Office in April, 2006.

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<sup>65</sup> Refer to "MCI Repair Invoice (Dallas) on 6/14/05", of which a copy is attached to this docket.

#### **d. Other Brake System Components:**

The motorcoach was equipped with a Bendix Tu-Flo750 compressor, rated at 16.5 CFM (cubic feet per minute) at 1250 rpm (revolutions per minute). It was also equipped with a Bendix AD-IP air dryer. For the purpose of documenting maintenance, the air compressor, air dryer and the primary air tank,<sup>66</sup> manufactured by Nelson, were shipped to Bendix Commercial Vehicle Systems in Elyria, Ohio for follow-up inspection and testing. On November 21<sup>st</sup>, 2005, in the presence of personnel from Bendix, MCI and NTSB, the shipment box was unsealed and opened. After the evidence was examined and photographed on November 21<sup>st</sup>, it was put back into the same box and sealed. At the request of the NTSB, the evidence was held in the sealed box at Bendix until the Sheriff's Department was prepared to receive it back into evidence, which occurred in April 2006. .<sup>67</sup>

The compressor was put in a vise and rotated it manually. According to Bendix engineers, it ordinarily takes 90 ft. lbs. to turn it; however, it took 300 ft. lbs. to break it free and 130 lbs. to turn it. It had obvious fire damage, and due to this abnormal condition no functional testing was done on this compressor. Further no date codes or serial numbers were discernable on the compressor housing. The AD-IP air dryer was disassembled and some of the desiccant<sup>68</sup> was found to be coated with oil, which decreases the ability of the material to collect water vapor. The level of performance (dew point depression) could not be tested due to fire damage to the air dryer assembly. After examining the desiccant, it was the opinion of Bendix engineers that it was not yet in a state where the desiccant needed to be replaced. An examination of the date code on the desiccant cartridge revealed that it was manufactured in 2001, which shows that it had been changed at least once since the coach was manufactured.

While at Bendix, the primary air tank was cut in two pieces for further examination. Due to the fire, there were ash-type contaminants found in it. However, it was the opinion of Bendix personnel that the amount of contaminants was not abnormal or excessive.

The motorcoach was equipped with a Meritor WABCO 6-channel ABS system, which includes wheel speed sensors and direct anti-lock braking control on all six wheels. The ABS ECU (electronic control unit) is mounted behind a panel in the rear cargo bay and was not damaged. The ECU bore serial number 00000487, part number 4461060700, and was manufactured in May, 1998. It was removed from the bus and shipped, along with other brake and wheel components, to ArvinMeritor, located in Troy, Michigan. The ECU was interrogated (downloaded) on November 9, 2005. The information extracted displayed a code for a "Right 3<sup>rd</sup> Sensor-Slip", which refers to the tag axle wheel on the right side. According to Meritor WABCO personnel, this fault code would only be registered if the condition lasted for over 16 seconds.<sup>69</sup> The fault code is indicating a difference in wheel speed between the right tag axle or 3R wheel relative to a calculated vehicle speed reference that lasted over 16 seconds. The code,

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<sup>66</sup> The primary air tank, located in the rear of the motorcoach, supplies air for braking the drive and tag axle.

<sup>67</sup> Due to the amount of evidence, both heavy and in large boxes, the Dallas County Sheriff's Department was not prepared to receive all of this into their normal evidence storage division. Therefore, ArvinMeritor, Bendix and Bridgestone/Firestone were requested to keep the evidence sealed and in a secure area, which they did (except Bridgestone/Firestone) until it could be returned in April 2006. Bridgestone/Firestone was requested in May of 2006 to return the evidence to USDOT in Ft. Worth, TX.

<sup>68</sup> The desiccant materials are small granules, about the size of a miniature pea, designed to absorb water vapor from the compressed air.

<sup>69</sup> A copy of the WABCO ABS ECU printout is attached to this docket.

in and of itself, does not necessarily indicate a total wheel lock condition relative to the calculated reference speed. Although the code was not date or time stamped, it is still consistent with the wheel lock-up that occurred on I-45 near Rice, Texas, which preceded the flat tire.

#### **4. Steering System:**

The front axle steering gearbox was a ZF, model 8098, integral power steering system. The tag axle steering gearbox was a ZF RAS (rear axle power steering system). Hydraulic fluid was pumped through the system with a Luk, engine mounted gear driven pump. No examination of the steering system or its components was conducted.

#### **5. Transmission:**

The coach was equipped with an Allison B500R transmission. It was equipped with a vane-stator hydraulic retarder. The transmission was electronically controlled and equipped with an ECU (electronic control unit). It was not possible to extract information from the ECU due to extensive fire damage.

#### **6. Tires:**

According to the MCI *Order Status Report* for this vehicle, the bus was originally equipped with Firestone, model HP3000, size 315/80R22.5 highway style tread tires. During the post-fire inspection, 7 of the 8 tires were burned to point they could not be fully identified. The right front tire was identified as a Dayton, size 11R22.5, with a G load rating<sup>70</sup> and the MCI maintenance manual calls for a J load rating<sup>71</sup> for the 16,500 lb.- rated front axle. The maximum inflation pressure for an 11R22.5 G load-rated tire is 105 psi and the maximum permitted weight capacity is 6,175 pounds. The J load-rated 315/80R22.5 tire can be inflated to a maximum of 120 psi and will carry 8,270 pounds, which meets MCI's requirements for the 16,500 lb -rated front axle. Although the tire specification placard for this bus was burned during the fire, a representative from MCI engineering stated that the placard specified that the front and tag axle tires be inflated to 120 psi. Since the G rated tire could only be inflated to 105 psi and could carry only 6,175 pounds, this means that the front tire mounted on the bus on September 21, 2005 could not be inflated to 120 psi and that the total load carrying capacity of both front tires was 12,350 lbs, or 4,150 lbs. less than what was required by the manufacturer, which would cause the front tires to be overloaded by about 33.6%

Only the 3R tire was burned to the point that the entire rubber portion of the tire was missing and only the metal wire and banding components were remaining. Further, the rim displayed a flat wear pattern on one side that had a cord height of about one inch (see photo #31). The remaining tires were partially burned or singed, but approximate tread depth measurements could be obtained. All of them were between 10/32<sup>nd</sup> and 18/32<sup>nd</sup> inch, well within the guidelines of the CVSA (Commercial Vehicle Safety Alliance) and the FMCSR (Federal Motor Carrier Safety Regulations).

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<sup>70</sup> The maximum G load rating for the Dayton 11R22.5 tire is 6170 lbs. @ 105 psi. cold. (Source: 2006 -Tire and Rim Association, Inc. - 2006)

<sup>71</sup> The maximum J load rating for a 315/80R22.5 tire is 8270 lbs. @ 120 psi. cold. (Source: 2006 - Tire and Rim Association, Inc. - 2006) Also, the J load-rated tire is specified in the MCI Maintenance Manual, Section 15, page 15C-1. (Source: MCI, 102E Series, Maintenance Manual, November 1997, attached to this docket.)

The 3R tire that had been changed near MP 241 at Rice, Texas, was removed from the spare tire compartment and examined and photographed. This tire also had a flat spot that wore through the tire, ultimately causing it to blow out. On the same side of the tire, in the location of the flat spot, the rim also had a flat spot with a cord height of approximately one inch (see photo # 6). This tire and rim, along with the 3R rim that was on at the time of the fire and other miscellaneous tire fragments, were crated and shipped to Bridgestone/Firestone in Akron, Ohio. On November 22, 2005, in the presence of representatives from Bridgestone/Firestone, MCI, ArvinMeritor and NTSB, the crate was unsealed and opened. The tire was examined and photographed by a forensic tire expert from Bridgestone/Firestone. On the following day, the tire was put back into the crate and re-sealed in the presence of the NTSB investigator, who signed and dated the sealed wooden crate.

On May 2, 2006, the NTSB Vehicle Group Chairman returned to the Bridgestone/Firestone facility in Akron for the purpose of allowing Bridgestone/Firestone personnel to take more photographs of the tire because of problems with the camera when the original photos were taken on November 22, 2005. The wooden crate was opened, the tire was removed and photos were taken. The tire was then placed back in the wooden crate and the crate was secured. After the crate was sealed shut, the NTSB investigator then signed and dated the crate lid. The crate is being temporarily stored in a secure evidence room at the Bridgestone/Firestone facility in Akron until space becomes available at the Dallas County Sheriff's Department evidence division, where it will be shipped to at a later date.

Larry L. Yohe  
Vehicle Group Chairman